

POWER PLANT (J86811)
FOR TRAFFIC DATA SUMMARIZER
OPERATING METHODS

1. GENERAL

1.01 The J86811 batteryless power plant is designed to furnish dc and ac power for use with the traffic data summarizer equipment associated with the Traffic Data Recording System No. 1A. The input power is supplied by either three-wire or two-wire, 117-volt, 60-Hz commercial ac service. The power plant incorporates ac distribution and protection of 117 volts by means of circuit breakers to the various loads of the traffic data summarizer. The dc power of -48, +16.8, -3, +60, +145, and ± 17.5 volts is furnished by semiconductor-type rectifiers as covered in Table A, which are a part of the power plant. The alarm circuit monitors the dc voltages and indicates the loss of output from any rectifier. When first starting the power plant, and after a commercial power failure, only the 48V1 and 48V2 rectifiers will be energized. The remainder of the power plant must be energized by manual operation of the START (S4) switch. An interlocking arrangement is provided between the +16.8 volt and -3 volt outputs that prevents the +16.8 volt rectifier from being turned on, unless the -3 volt output from the AUX rectifier is available. The AUX, -48V3, ± 17.5 V, and 16.8V rectifiers will shut down upon the loss of the -3 volt output. In addition, an alarm is provided to indicate a reduction of the +16.8 volt rectifier to +14.4 volts, and an alarm is provided which will shut down the AUX, -48V3, ± 17.5 , and 16.8V rectifiers should it increase to +20.0 volts.

1.02 The J87220A, J87221A, and J87267A rectifiers are mounted on the front of the cabinet and supply the logic data circuits, bias voltage for transistors, plate supply for voltage indicator tubes, plate supply for nixie counter tubes and FM voice band data receivers. The J87205A rectifiers are mounted on a swinging gate in the rear of the cabinet which provides -48 volt power for alarm lamps and control relays and -48 volt power for the traffic data summarizer equipment.

TABLE A

RECTIFIER DC OUTPUT DATA

UNIT	VOLTAGE	CURRENT	NUMBER OF UNITS
	VOLTS	AMPERES	
J87205A	-48	8	3
J87220A	+16.8	75	1
J87221A	-3	3.5	1
	+60	0.15	
	+145	0.045	
J87267A	+17.5	3.2	1
	-17.5	1.6	

Caution: *The voltages in the cabinet may exceed 230 volts to ground and between parts of the circuits. Every precaution should be observed to avoid any contact with exposed metal parts or terminals when the plant is in operation. Do not allow a test pick to touch two metal parts at the same time or dangerous and destructive short circuits may occur.*

1.03 A control panel, meter and alarm panel, and an ac distribution panel are also part of the cabinet assembly which are mounted on the front of the cabinet above the rectifiers. The SUMMARIZER DC ELECTRONICS SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches are required to disconnect the summarizer loads of the AUX, +16.8, and -48 volt rectifiers for maintenance purposes or during periods when the summarizer is not required. With these two switches in the OFF position, the tape transports and time of day register circuits will still operate, but the input data receivers will not operate. The dc outputs of all rectifiers may be monitored singly with the multi-range dc voltmeter (M1) by rotating

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the OUTPUT VOLTS (S3) switch to the desired position.

1.04 The instructions in this practice are based on the following schematic drawings. For a detailed description of operation, see the corresponding circuit description.

SD-81499-01 Rectifier Circuit—Semiconductor Type—Ferroresonant Regulation—-48 Volts, 8 Amperes DC—J87205A

SD-81561-01 Rectifier Circuit—Semiconductor Type—Ferroresonant Regulation—-3 Volts, 3.5 Amperes DC—+60 Volts, 0.15 Ampere DC—+145 Volts, 0.045 Ampere DC—J87221A

SD-81592-01 Power Plant Circuit for Traffic Data Summarizer

SD-81721-01 Power Supply Circuit—Semiconductor Type—Ferroresonant Regulation—+16.8 Volts, 75 Amperes DC—J87220A

SD-81722-01 Rectifier Circuit—Semiconductor Type—Ferroresonant Regulation—+17.5 Volts, 3.2 Amperes DC—17.5 Volts, 1.6 Amperes DC—J87267A

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
2W17A	Cord (W2W cord, 6 feet long, equipped with one No. 310 plug and two No. 360 tools)
KS-6278	Connecting Clip
TEST APPARATUS	
KS-8039	DC Volt-Milliammeter
KS-14510	Volt-Ohm-Milliammeter
—	35F Test Set

3. OPERATION

3.01 Starting Procedure After a Disconnect of All Power to the Traffic Data Summarizer

- (1) All circuit breakers will be in the OFF position.
- (2) Operate the MAIN (CB1) circuit breaker to the ON position. The DS1 LINE 1 and DS2 LINE 2 neon lamps light.
- (3) Operate the ON-OFF switch at the ± 17.5 volt rectifier (J87267A) to the ON position.
- (4) Operate the -48V1 POWER FIL TRANS & CLOCKS (CB5) and -48V2 POWER (CB4) circuit breakers to the ON position to energize the -48V1 and -48V2 rectifiers, respectively. The NV1 -48V1 and NV2 -48V2 no-voltage lamps are extinguished and the NV3 -48V3 no-voltage lamp lights. An audible bell sounds.
- (5) Rotate the OUTPUT VOLTS (S3) switch, first to -48V1 position and then to the -48V2 position while observing the multi-range voltmeter (M1) for an indication of -48 volts at each position.
- (6) Operate the SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches to the ON position. The NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V no-voltage lamps, and the LV +16.8V low-voltage lamp light.
- (7) Operate the BLOWER 16.8V and AUX POWER (CB2) circuit breaker to the ON position.
- (8) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. The NV5 +60V, NV6 +145V no-voltage lamps, and the LV +16.8V low-voltage lamp will also extinguish.
- (9) Operate the -48V3 and 17.5V POWER circuit breaker (CB3) to the ON position to energize the -48V3 and ± 17.5 V rectifiers. The NV3 -48V3, NV7 +17.5V, and NV8 -17.5V no-voltage lamps extinguish.

Note: With circuit breakers CB1 through CB5 operated to the ON position, all alarm indicating lamps should be extinguished.

- (10) Operate circuit breakers CB6 through CB11 (see Table B) to the ON positions to apply ac voltage to the traffic data summarizer equipment cabinets.

3.02 *Disconnecting All Power to the Traffic Data Summarizer*

- (1) First operate circuit breakers CB2 through CB11 (see Table B); then operate the MAIN (CB1) circuit breaker to the OFF position. The DS1 LINE 1 and DS2 LINE 2 neon lamps extinguish and all power is removed to the traffic data summarizer.
- (2) Operate the SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) to the OFF position.
- (3) Operate the ON-OFF switch at the ± 17.5 volt rectifier (J87267A) to the OFF position.

3.03 *Starting Procedure After a Partial Turn-Down of Power*

- (1) The MAIN (CB1), the -48V1 POWER FIL TRANS & CLOCKS (CB5), and the CB6 through CB11 (see Table B) circuit breakers will be in the ON position. The BLOWER 16.8V and AUX POWER (CB2), the -48V3 and 17.5 POWER (CB3), and the -48V2 POWER (CB4) circuit breakers will be in the OFF position. The DS1 LINE 1 and DS2 LINE 2 neon lamps will be lighted. The NV2 through NV8 no-voltage lamps and the LV low-voltage lamp are lighted.
- (2) Operate the -48V2 POWER (CB4) circuit breaker to the ON position. The NV2 -48V2 NO VOLTAGE lamp extinguishes.
- (3) Operate the OUTPUTS VOLTS (S3) switch first to the -48V1 position and then to the -48V2 position while observing the multi-range voltmeter (M1) for an indication of -48 volts at each position.
- (4) Operate the BLOWER 16.8V and AUX POWER (CB2) circuit breaker to the ON position.

- (5) Operate the START (S4) momentary contact toggle switch, until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. The NV5 +60V, NV6 +145V no-voltage lamp, and the LV +16.8V low-voltage lamp will also extinguish.

- (6) Operate the -48V3 and 17.5V POWER (CB3) circuit breaker to the ON position to energize the -48V3 and ± 17.5 V rectifiers. The NV3 -48V3, NV7 +17.5V, and NV8 -17.5V no-voltage lamps extinguish.

3.04 *Partial Turn-Down of Power to the Traffic Data Summarizer*

- When the traffic data summarizer equipment is not being used and the time of day register circuit is to remain operable, operate the BLOWER 16.8V and AUX POWER (CB2), the -48V3 and 17.5 POWER (CB3), and the -48V2 POWER (CB4) to the OFF position. The NV2 through NV8 no-voltage lamps and the LV low-voltage lamp light and an audible bell sounds.

3.05 *Starting Procedure After a Disconnect of the Summarizer Loads*

- (1) Operate the SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches to the ON position. The NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V no-voltage lamps, and the LV +16.8V low-voltage lamp light.
- (2) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. This permits the AUX, -48V3, ± 17.5 V, and 16.8V rectifiers to energize and provide power to their respective loads. All alarm indicating lamps extinguish.

3.06 *Disconnecting the Summarizer Loads of the AUX, 16.8, and -48 Volt Rectifiers*

- When the summarizer loads of the AUX, 16.8V, and -48V rectifiers are to be disconnected for maintenance purposes or during a period when the summarizer is not required, operate the SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches to the

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OFF position. The NV3 -48V3 lamp lights and the alarm bell sounds. With these switches in the OFF position, the tape transports and time of day register circuits will still operate, but the input data receivers will not operate.

3.07 Starting Procedure After a Commercial Power Failure

(1) After a commercial power failure, only the -48V1 and -48V2 rectifiers will be energized. All circuit breakers will be in the ON position. The NV3 through NV8 no-voltage lamps and the LV low-voltage lamp are lighted, and an audible bell sounds.

(2) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. This permits the AUX, -48V3, $\pm 17.5V$, and 16.8V rectifiers to energize and provide power to their respective loads. All alarm indicating lamps extinguish and the alarm bell is silenced.

3.08 Starting Procedure After a High-Voltage (HV +16.8) Shutdown

(1) After a high-voltage shutdown of the 16.8V rectifier, only the -48V1 and -48V2 rectifiers will be energized. All circuit breakers will be in the ON position. The NV3 through NV8 no-voltage lamps and the HV high-voltage lamp are lighted, and an audible bell sounds.

(2) After the cause of the shutdown has been corrected, depress the 16.8V HVR RESET button.

(3) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. This permits the AUX -48V3, ± 17.5 , and 16.8V rectifiers to energize and provide power to their respective loads. All alarm indicating lamps extinguish and the alarm bell is silenced.

4. ROUTINE CHECKS

4.01 The ac input and distribution voltage and the dc output voltages of the various rectifiers should be checked periodically or whenever experience

indicates a need. These checks should be made during a period when the traffic data summarizer equipment is not being used.

(a) **AC Input Voltage Check:** Using the KS-14510 volt-ohm-milliammeter set for the 300-volt ac scale, connect the leads of the meter across TS1 terminals 1 and 2 and then connect the leads of the meter across TS1 terminals 2 and 3, in turn.

Requirement: The volt-ohm-milliammeter shall indicate $117V \pm 10$ percent at each set of terminals.

(b) **AC Distribution Check:**

(1) All circuit breakers MAIN (CB1), BLOWER 16.8V and AUX POWER (CB2), -48V3 and 17.5V POWER (CB3), -48V2 POWER (CB4), -48V1 POWER FIL TRANS & CLOCKS (CB5), OUTPUT TAPE TRANSPORTS & BLOWER J (CB6), BLOWERS F, G, H, and POWER OUTLETS (CB7), TAPE TRANSPORT 0 & BLOWER C (CB8), TAPE TRANSPORT 1 & BLOWER D (CB9), TAPE TRANSPORT 2 & BLOWER E (CB10), TAPE TRANSPORT 3 (CB11) should be in the OFF position.

(2) The SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches shall be in the ON position.

(3) Operate the MAIN (CB1) circuit breaker to the ON position.

Requirement: The DS1 LINE 1 lamp and the DS2 LINE 2 lamp, when provided, light.

(4) Connect the KS-14510 volt-ohm-milliammeter, using the 300-volt ac scale, between the terminals shown on Table B.

Requirement: The volt-ohm-milliammeter shall indicate $117V \pm 10$ percent for each step.

(c) **Rectifier DC Output Voltage Check:**

(1) All circuit breakers shall be in the OFF position. [See (b)(1).]

(2) The SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC

TABLE B

STEP	OPERATE	CONNECT VOLTMETER	
		TERM. STRIP	*TERM. NOS.
1	-48V1 POWER, FIL TRANS & CLOCKS (CB5)	TB1 in RECT -48V1	± and G
2	-48V2 POWER (CB4)	TB1 in RECT -48V2	± and G
3	BLOWER, 16.8V & AUX POWER (CB2) & START (S4) SWITCH	TS1 in RECT 16.8V	INPUT
4	-48V3 AND 17.5V POWER (CB3)	TS1 in AUX RECT	1 and 2
5		TB1 in RECT -48V3	± and G
6		TS1 in RECT 17.5V	± and G
7		TS3	1 and Neutral
8	OUTPUT TAPE TRANSPORT & BLOWER J (CB6)	TS3	2 and Neutral
9	BLOWERS F, G, & H AND POWER OUTLETS (CB7)	TS3	3 and Neutral
10	TAPE TRANSPORT 0 & BLOWER C (CB8)	TS3	4 and Neutral
11	TAPE TRANSPORT 1 & BLOWER D (CB9)	TS3	5 and Neutral
12	TAPE TRANSPORT 2 & BLOWER E (CB10)	TS3	6 and Neutral
13	TAPE TRANSPORT 3 (CB11)	TS3	7 and Neutral

* Use TS1 terminal 2 for the neutral connection.

RELAY SUPPLY (S2) switches shall be in the ON position.

(3) Operate the MAIN (CB1) circuit breaker to the ON position.

Requirement: The DS1 LINE 1 lamp and the DS2 LINE 2 lamp, when provided, light.

(4) Using the KS-8039 volt-milliammeter set for the 75-volt scale for Steps 1 through 8 and the 150-volt scale for Step 9, connect the black (-) lead and the red (+) lead of the meter to the respective terminals as shown on Table C.

Requirement: The voltage indicated on the OUTPUT VOLTS (M1) voltmeter shall be within 5 percent of the KS-8039 volt-milliammeter.

ALARM AND CONTROL CHECKS

Caution: The following checks should be made only when the traffic data summarizer equipment is not being used.

4.02 16.8-Volt Rectifier Alarm Check

(1) Remove the REG CONT (F1) fuse of the 16.8V (J87220A) rectifier.

Requirement: The LV +16.8V LOW alarm lamp lights and the alarm bell sounds.

TABLE C

STEP	CIRCUIT BREAKER TO BE OPERATED	VOLTAGE MEASUREMENTS		
		BETWEEN TERMINALS	KS-8039 VOLTAGE	OUTPUT VOLTS (S1) SWITCH
1	-48V1 POWER, FIL TRANS & CLOCKS (CB5)	TS4, 1 & 3	-45 to -52V	-48V1
2	-48V2 POWER (CB4)	TS4, 7 & 3	-45 to -52V	-48V2
3	BLOWER, 16.8V & AUX POWER (CB2) & START (S4) switch	16.8V RECTIFIER output terminals	+16.8 ±2%	+16V
4	-48V3 AND 17.5V POWER (CB3)	TS4, 9 & 15	-45 to -52V	-48V3
5		TS4, 18 & 17	+17.5V ±1%	+17.5V
6		TS4, 19 & 18	-17.5V ±1%	-17.5V
7		TS4, 20 & 15	-3V ±3%	-3V
8		TS4, 15 & 21	+60V ±10%	+60V
9		TS4, 23 & 22	+145V ±10%	+145V

(2) Replace the REG CONT (F1) fuse.

Requirement: The LV +16.8V LOW alarm extinguishes and the alarm bell is silenced.

(3) Remove the F2 fuse on the 16.8V (J87220A) rectifier.

Requirement: The LV +16.8V LOW alarm lamp lights and the alarm bell sounds.

(4) Replace the F2 fuse.

Requirement: The LV +16.8V LOW alarm lamp extinguishes and the alarm bell is silenced.

4.03 High- and Low-Voltage Alarm Control Check

(1) Operate the BLOWER 16.8V and AUX POWER (CB2) circuit breaker to the OFF position.

Requirement: The AUX, -48V3, ±17.5V, and 16.8V rectifiers will shut down. The NV3 through NV8 no-voltage lamps and the LV low-voltage lamps light, and an audible alarm bell sounds.

(2) Remove the REG CONT (F1) fuse on the 16.8V (J87220A) rectifier.

(3) Disconnect the ground lead from the negative terminal of the HLV relay.

(4) Operate the OUTPUT VOLTS (S3) switch to the OFF position.

(5) Using the 35F test set, operate all the black and red slides to the extreme right side, and check that the key and switches are as follows.

KEYS	POSITION
BAT & GRD CO	NORMAL
REV	NORMAL
VM	OPERATED (75 VOLT)
NO. 1 TO NO. 4 TELEGRAPH	OPEN

SWITCH	POSITION
G	OPEN

(6) Using one of the 2W17A cords, connect the 310 plug to the T & R jack of the 35F test set. Connect the T lead of the cord with the KS-6278 connecting clip to the negative terminal of the HLV relay. Connect the R lead of the cord with the KS-6278 connecting clip to the positive terminal of the HLV relay.

(7) Using the other 2W17A cord, connect the 310 plug to the BAT & GRD jack of the 35F test set. Connect the T lead of the cord with the KS-6278 connecting clip to the -48V terminal on the relay test block. Connect the R lead of the cord with the KS-6278 connecting clip to the GRD terminal on the relay test block.

(8) Close the locking lever of the No. 1 telegraph key and adjust the red and black slides No. 1 until the voltmeter indicates 16.8 volts. This is accomplished by moving the red slide No. 1 toward the left for a coarse adjustment and the black slide No. 1 toward the left for a fine adjustment.

(9) Decrease the voltage by moving the red and black slides No. 1 to the right until the LV +16.8V LOW lamp lights.

Requirement: The voltmeter shall indicate 14.4 ± 0.02 volts.

(10) Increase the voltage by moving the red and black slides No. 1 to the left until the LV +16.8V LOW lamp extinguishes.

Requirement: The voltmeter shall indicate 16.8V.

(11) Increase the voltage by moving the red and black slides No. 1 to the left until the HV +16.8V HIGH lamp lights.

Requirement: The voltmeter shall indicate 20.0 ± 0.02 volts.

(12) Decrease the voltage by moving the red and black slides No. 1 to the right until the voltmeter indicates 16.8V.

(13) Depress the 16.8V HVR RESET button.

Requirement: The HV +16.8V HIGH lamp extinguishes.

(14) Disconnect the 35F test set.

(15) Reconnect the ground lead to the negative terminal of the HLV relay.

(16) Replace the REG CONT (F1) fuse on the 16.8V (J87220A) rectifier.

(17) Operate the 16.8V and AUX POWER (CB2) circuit breaker to the ON position.

(18) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. This permits the AUX, -48V3, $\pm 17.5V$, and 16.8V rectifiers to energize and provide power to their respective loads. All alarm indicating lamps extinguish.

Note: For adjustment of the HLV relay refer to the circuit requirement table and Section 040-254-701.

4.04 Auxiliary Rectifier Alarm and Shutdown Check

(1) Remove the F1 fuse on the AUX (J87221A) rectifier.

Requirement: The AUX, -48V3, $\pm 17.5V$, and 16.8V rectifiers will shut down. The NV3 through NV8 no-voltage lamps light, and the LV low-voltage lamps light, and an audible bell sounds.

(2) Replace the F1 fuse on the AUX rectifier.

(3) Operate the START (S4) momentary contact toggle switch until the NV4 -3V no-voltage lamp extinguishes, indicating that the CO1 contactor is energized. This permits the AUX, -48V3, $\pm 17.5V$, and 16.8V rectifiers to energize and provide power to their respective loads. All alarm indicating lamps extinguish.

4.05 +17.5 Volt Rectifier Alarm Check

(1) Operate the S1 switch on the $\pm 17.5V$ (J87267A) rectifier to the OFF position.

Requirement: The NV7 +17.5V and NV8 -17.5V lamps light and the alarm bell sounds.

(2) Operate the S1 switch to the ON position.

Requirement: The NV7 +17.5V and NV8 -17.5V lamps extinguish and the alarm bell is silenced.

4.06 -48 Volt Rectifiers Alarm Check

- (1) Remove the F1 fuse on the -48V1 (J87205A) rectifier.

Requirement: The NV1 -48V1 no-voltage lamp lights and the alarm bell sounds.

- (2) Replace the F1 fuse.

Requirement: The NV1 -48V1 no-voltage lamp extinguishes and the alarm bell is silenced.

- (3) Remove the F1 fuse on the -48V2 (J87205A) rectifier.

Requirement: The NV2 -48V2 lamp lights and the alarm bell sounds.

- (4) Replace the F1 fuse.

Requirement: The NV2 -48V2 no-voltage lamp extinguishes and the alarm bell is silenced.

- (5) Remove the F1 fuse on the -48V3 (J87205A) rectifier.

Requirement: The NV3 -48V3 no-voltage lamp lights and the alarm bell sounds.

- (6) Replace the F1 fuse.

Requirement: The NV3 -48V3 lamp extinguishes and the alarm bell is silenced.

4.07 -3V ADJ Adjustment of the AUX Rectifier

- (1) Using the KS-8039 volt-milliammeter set for the 7.5-volt scale, connect the black (-) lead

of the meter to the -J1 jack and the red (+) lead of the meter to the +J2 jack on the AUX rectifier.

Requirement: The volt-milliammeter should indicate between -2.9 and -3.1 volts.

- (2) If the output voltage is out of limits, rotate the -3V ADJ potentiometer clockwise to increase the output voltage or counterclockwise to decrease the output voltage.

- (3) Disconnect the volt-milliammeter.

5. TROUBLE

5.01 In general, troubles which occur in the J86811 power plant will be identified by a trouble indicating lamp or a combination of trouble indicating lamps located on the control panel. In most cases, the trouble condition will probably be in one of the six associated rectifiers. Table D will assist in analyzing the lamp indications to determine the cause of the trouble condition.

5.02 Trouble Chart: Test jacks are provided on the front panel of each rectifier to check the dc output voltages. In addition, point-to-point voltages are shown on the schematic drawings of each rectifier. These voltages are shown for nominal line (117V, 60 Hz) and no load conditions, and are indicated at the point of measurement. After analyzing the trouble condition, using Table D, operate the SUMMARIZER DC ELECTRONIC SUPPLY (S1) and SUMMARIZER DC RELAY SUPPLY (S2) switches to OFF to disconnect the summarizer load from the rectifiers. Use the following chart as an aid in locating and clearing the trouble in the affected unit. After the trouble has been corrected, place the power plant in service as outlined in 3.05.

TABLE D

LAMP INDICATIONS	TROUBLE CONDITIONS
NV1 -48V1	-48V1 rectifier failure or -48V1 POWER, FIL TRANS & CLOCKS (CB5) circuit breaker tripped.
NV2 -48V2	-48V2 rectifier failure or -48V2 POWER (CB4) circuit breaker tripped.
NV3 -48V3	-48V3 rectifier failure.
NV3 -48V3, NV7 +17.5V, NV8 -17.5V	-48V3 and 17.5V Power (CB3) circuit breaker tripped.
NV3 -48V3, NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V, LV +16.8V	-3 volt output failure of AUX rectifier or BLOWER, 16.8V and AUX POWER (CB2) circuit breaker tripped.
NV3 -48V3, NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V, HV +16.8V	High-voltage shutdown of 16.8 VOLT rectifier.
NV5 +60V	+60 volt output failure of AUX rectifier.
NV6 +145V	+145 volt output failure of AUX rectifier.
NV7 +17.5V	+17.5 volt output failure of $\pm 17.5V$ rectifier.
NV8 -17.5V	-17.5 volt output failure of $\pm 17.5V$ rectifier.
NV7 +17.5V, NV8 -17.5V	$\pm 17.5V$ rectifier failure.
LV +16.8V	+16.8 volt output failure of 16.8 VOLT rectifier.
NO LAMPS (POWER PLANT SHUT-DOWN)	MAIN (CB1) circuit breaker tripped.

Caution: Before performing any continuity or short-circuit checks in the rectifiers, disconnect the input power and ensure

that all capacitors are discharged by placing a 100-ohm resistor across the terminals of each capacitor.

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TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
-48V1 rectifier failure (NV1 -48V1 lamp lighted)	-48V1 POWER, FIL TRANS & CLOCKS (CB5) circuit breaker tripped to OFF	Use KS-14510 meter and check continuity of T1 transformer in rectifier. Operate circuit breaker to ON.
	F1 AC input fuse in -48V1 rectifier operated	Replace fuse. If it operates, use KS-14510 meter and check for short circuits in the T1 trans- former, CR1 and CR2 silicon rectifiers, or C1 through C5 capacitors in rectifier.
	No dc output voltage measured at the +J1 and -J2 jacks of -48V2 rectifier	Ensure that $\pm 117V$ is present at \pm and GRD terminals at TB1 AC INPUT of rectifier; then check point to point voltages as shown on SD-81499-01 using KS-14510 meter.
-48V2 rectifier failure (NV2 -48V2 lamp lighted)	-48V2 POWER (CB4) cir- cuit breaker tripped to OFF	Use KS-14510 meter and check continuity of T1 transformer. Operate circuit breaker to ON.
	F1 AC input fuse in -48V2 rectifier operated	Replace fuse. If it operates, use KS-14510 meter and check for short circuits in the T1 trans- former, CR1 and CR2 silicon rectifiers, or C1 through C5 capacitors in rectifier.
	No dc output voltage measured at the +J1 and -J2 jacks of -48V2 recti- fier	Ensure that $\pm 117V$ is present at \pm and GRD terminals at TB1 AC INPUT of rectifier; then check point to point voltages as shown on SD-81499-01 using KS-14510 meter.
-48V3 rectifier failure (NV3 -48V3 lamp lighted)	F1 AC input fuse in -48V3 rectifier operated	Replace fuse. If it operates, use KS-14510 meter and check for short circuits in the T1 trans- former, CR1 and CR2 silicon rectifiers, or C1 through C5 capacitors in rectifier.
	No dc output voltage measured at the +J1 and -J2 jacks of -48V3 recti- fier	Ensure that $\pm 117V$ is present at \pm and GRD terminals at TB1 AC INPUT of rectifier; then check point to point voltages as shown on SD-81499-01 using KS-14510 meter.
-3 volt output failure of AUX rectifier (NV3 -48V3, NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V, LV +16.8V lamps lighted)	No or low dc output voltage measured at the +J1 and -J2 jacks	Check adjustment of -3V ADJ potentiometer as outlined in 4.07. Check point to point voltages associated with the -3V portion of the AUX rectifier as shown on SD-81561-01 using KS-14510 meter.

TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
	BLOWER, 16.8V and AUX POWER (CB2) circuit breaker tripped to OFF	Use KS-14510 meter and check continuity of T1 transformer in rectifier.
	F1 fuse in AUX rectifier operated	Replace fuse. If it operates, use KS-14510 meter and check for short circuits in the T1 transformer, CR5 through CR8 and CR9 through CR12 silicon rectifiers.
High voltage shutdown of 16.8V rectifier (NV3 -48V3, NV4 -3V, NV5 +60V, NV6 +145V, NV7 +17.5V, NV8 -17.5V, HV +16.8V lamps lighted)	High dc output voltage measured at the +J1 and -J2 jacks of 16.8V rectifier	Check point to point voltages as shown on SD-81721-01 using KS-14510 meter.
	Defective secondary winding of T1 transformer	Operate the BLOWER, 16.8V AUX POWER (CB2) circuit breaker to OFF. Use KS-14510 meter and check continuity of T1 transformer.
	Defective C1.1, C1.2, or C1.3 capacitor	Make sure (CB2) circuit breaker is OFF; then remove the lead from one side of each capacitor. Check the capacitors using the KS-14510 meter (see caution).
+60 volt output failure of AUX rectifier (NV5 +60V lamp lighted)	No dc output voltage measured at the -J3 and +J4 jacks of the AUX rectifier	Check point to point voltages associated with the +60 volt portion of the AUX rectifier as shown on SD-81561-01 using the KS-14510 meter.
	Defective CR5 through CR8 silicon rectifiers	Operate the BLOWER, 16.8V AUX POWER (CB2) circuit breaker to OFF. Disconnect the leads between the bridge of CR5 through CR8 diodes. Use the KS-14510 meter and connect the black (-) lead to the cathode and the red (+) lead to the anode of each diode, in turn. The reverse check should indicate on the high portion of the meter. Reverse the meter leads. The forward check should indicate on the low portion of the meter.

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TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
+145 volt output failure of AUX rectifier (NV6 +145V lamp lighted)	No dc output voltage measured at the -J5 and +J6 jacks of the AUX rectifier	Check point to point voltages associated with the +145 volt portion of the AUX rectifier as shown on SD-81561-01 using the KS-14510 meter.
	Defective CR9 through CR12 silicon rectifiers	Operate the BLOWER 16.8V and AUX POWER (CB2) circuit breaker to OFF. Disconnect the leads between the bridge of CR9 through CR12 diodes. Use the KS-14510 meter and connect the black (-) lead to the cathode and the red (+) lead to the anode of each diode, in turn. The reverse check should indicate on the high portion of the meter. Reverse the meter leads. The forward check should indicate on the low portion of the meter.
+17.5 volt output failure of $\pm 17.5V$ rectifier (NV7 +17.5V lamp lighted)	No dc output voltage measured at the +J1 and -J2 jacks of the $\pm 17.5V$ rectifier	Check point to point voltages associated with the +17.5V portion of the $\pm 17.5V$ rectifier as shown on SD-81722-01 using the KS-14510 meter.
-17.5 volt output failure of $\pm 17.5V$ rectifier (NV8 -17.5V lamp lighted)	No dc output measured at the +J2 and -J3 jacks of the $\pm 17.5V$ rectifier	Check point to point voltages associated with the -17.5V portion of the $\pm 17.5V$ rectifier as shown on SD-81722-01 using the KS-14510 meter.
$\pm 17.5V$ rectifier failure (NV7 +17.5V, NV8 -17.5V lamps lighted)	Defective CR1 silicon rectifier	Disconnect the R and BK lead from the CR1 rectifier. Use the KS-14510 meter and connect the black (-) lead to J2 jack and the red (+) lead to the R terminal of the CR1 rectifier; then connect the red (+) lead to J2 jack and the black (-) lead to BK terminal of the CR1 rectifier and check point to point voltages.
	S1 switch operated to OFF	Operate the S1 switch on the rectifier to ON.

TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
+16.8 volt output failure of 16.8 volt rectifier	Low dc output voltage measured at +J1 and -J2 jacks of the 16.8 volt rectifier	Check point to point voltages as shown on SD-81721-01.
	Operated REG CONT F1 or F2 fuse	If REG CONT F1 fuse is operated check winding of HLV relay using KS-14510 meter. If F2 fuse is operated, check for overload from summarizer equipment. Replace operated fuse.
	Operated KS-15815, L38 fuse	Use KS-14510 meter and check for short circuits in the T1 transformer and C1.1, C1.2, and C1.3 capacitors. Replace operated fuse.
Power plant shutdown (No lamps lighted)	BLOWER, 16.8V and AUX POWER (CB2) circuit breaker tripped (Defective AUX or 16.8 VOLT rectifier)	Make sure SUMMARIZER DC ELECTRONIC SUPPLY (S1) switch is OFF. Operate CB2 circuit breaker to ON; then operate the (S1) switch to ON. If the circuit breaker trips before operating the (S1) switch, the 16.8 VOLT rectifier is defective. If the circuit breaker trips after operating the (S1) switch, the AUX rectifier is defective. Use the KS-14510 meter and check for short circuits in the T1 transformers.